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(54) Rotor Assembly for an electric machine

Rotoranordnung für eine elektrische Maschine

Assemblage de roteur pour machines électriques

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Description

Field of the invention

The present invention relates to rotor assemblies for electric machines.

Description of the related art

In the design of alternators, an important concern is the noise generated by the alternator when it operates. One way this concern is addressed in some "claw pole" type alternators is through the insertion of a plastics silencer in the rotor assembly of the alternator. This silencer fills the gaps between the fingers of the pole pieces of the alternator, causing the outer surface of the rotor to be relatively smooth. Windage noise generated by the rotor when it rotates is thus reduced.

Such a use of a silencer introduces a concern, however. Rotors in alternators rotate at very high speeds (some in the vicinity of 20,000 revolutions per minute or more). The centrifugal forces developed at such speeds are very substantial and tend to cause radial expansion of the silencer. Such tendency toward radial expansion is compounded by the high underhood temperatures of many motor vehicles. If the radial expansion is not limited, it can cause the silencer to rub against the stator of the alternator. Failure of the alternator can result.

One possible way to prevent such expansion is illustrated in U.S. Patent Number 4,617,485 or EP-A-198 095, issued to Nakamura. This patent discloses in Figures 3 and 4 a silencer with portions 3-b which extend under the pole fingers of the pole pieces of the rotors. However, such a configuration can have problems of its own. The configuration in that patent has a large amount of contact area between the plurality of pole fingers of the rotor and the silencer. Such a large contact area can create a significant frictional force to be overcome in pressing the two pole pieces together to assemble the rotor. Further, such a silencer configuration makes it difficult to varnish the interior of the assembled rotor, varnish often being applied to a rotor to improve its structural integrity.

Object of the invention

Therefore, the invention seeks to provide a silencer assembly that helps reduce rotor noise, does not present significant obstacles to rotor assembly and which facilitates getting varnish to the interior of the rotor.

Summary of the invention

In accordance with the present invention, there is provided a rotor for an electric machine as hereinafter set forth in Claim 1 of the appended claims.

The invention further provides an alternator as hereinafter set forth in Claim 10 appended to claim 1.

Brief description of the drawings

The invention will now be described further, by way of example, with reference to the accompanying drawings, in which :-

Figure 1 is an exploded view of a rotor 10 according to one embodiment of the invention,
Figure 2 is a cross-section of a pole finger 16 of rotor 10 of Figure 1,
Figure 3 is a side view of rotor 10 of Figure 1 in its assembled state, along with a partial cross-sectional view of a stator 23, and
Figure 4 is a perspective view of silencer 22 of rotor 10 of Figure 1.

Detailed description of the preferred embodiment

Referring to Figures 1, 2 and 3, a rotor assembly 10 according to one embodiment of the present invention will be described. Those skilled in the art will recognise rotor assembly 10 as a "claw pole" type rotor. Rotor assembly 10 comprises first pole piece 12 and second pole piece 14. Pole pieces 12 and 14 comprise pole fingers (for example, pole fingers 16). Each pole finger 16, as shown in the section of Figure 2, has two lateral surfaces 17. Disposed between pole pieces 12 and 14 is field coil assembly 18. Further disposed between pole pieces 12 and 14 is a noise ring 20. Noise ring 20 is a metallic ring that bears against the interior radius defined by pole fingers 16 of pole pieces 12 and 14. Noise ring 20 helps to reduce noise caused by vibration of pole fingers 16 as rotor assembly 10 rotates.

Also disposed between pole pieces 12 and 14 is a silencer 22. Silencer 22 is designed to fill substantially the gaps between pole fingers 16 of pole pieces 12 and 14 when rotor 10 is assembled. Silencer 22 is preferably made of non-ferromagnetic material, more preferably a plastics material, more preferably still nylon. Silencer 22 will be further described below.

Rotor assembly 10 also includes a shaft 21, on which the pole pieces 12 and 14 are mounted for rotation therewith. Rotor assembly 10 is rotatably mounted inside the housing (not shown) and stator 23 of an alternator (a portion of stator 23 is shown in cross-section in Figure 3).

Referring now additionally to Figure 4, silencer 22 comprises silencing portions 24 adapted to fit in the gaps between pole fingers 16 of pole pieces 12 and 14. Silencer 22 further comprises bridging portions 26 connecting silencing portions 24. These bridging portions are preferably designed to extend beneath the tips of fingers 16 of pole pieces 12 and 14. At least partially through contact between bridging portions 26 and the tips of pole fingers 16, silencer 22 is held in place in rotor assembly 10.

Extending from the sides of silencing portions 24 are projections 28. Projections 28 are designed to cooperate with lateral surfaces 17 of pole fingers 16 to restrain outward radial movement of silencing portions 24. Projections 28 can be located and sized such that they bear against lateral surfaces 17 of pole fingers 16 when rotor assembly 10 is not rotating (i.e., "at rest"). Projections 28 can alternatively be sized and located such that there is contact with lateral surfaces 17 of pole fingers 16 only after some limited amount of outward radial movement of silencing portions 24 has occurred.

Projections 28 are preferably shorter in a direction along lateral surfaces 17 that the length of lateral surfaces 17. Furthermore, projections 28 are preferably substantially shorter in that direction than the length of lateral surfaces 17. The preferred length of projections 28 in that direction is about three millimetres.

Preferably, there is contact between pole fingers 16 and silencer assembly 22 only at bridging portions 26 and (optionally, as described above) at projections 28. Such a situation provides two benefits. First, assembly of rotor assembly 10 is accomplished without undue effort, because of the relatively small contact area between silencer 22 and pole pieces 12 and 14. The pressing together of pole pieces 12 and 14 thus does not require much force. Second, after assembly of rotor assembly 10, varnish can be applied to the exterior of rotor assembly 10 and it will be able to flow around the sides of pole fingers 16 and to the interior of rotor assembly 10. Such application of varnish enhances the structural integrity of rotor assembly 10.

Claims

1. A rotor for an electrical machine, said rotor (10) comprising:

   first and second pole pieces (12,14) together defining an axis of rotation, said pole pieces (12,14) each having pole fingers (16) extending generally parallel to said axis of rotation, said pole fingers (16) having lateral surfaces (17), said pole fingers (16) of said pole pieces intermeshed with one another, each pair of adjacent intermeshed pole fingers (16) further defining a gap therebetween; and
   a silencer (22) comprising silencing portions (24) at least partially filling said gaps, projections (28) adapted to cooperate with said lateral surfaces (17)of said pole fingers (16) to limit radial movement of said silencing portions (24) away from said axis of rotation of said rotor (10).

2. A rotor as claimed in Claim 1, wherein said silencer (22) is substantially constructed of non-ferromagnetic material.

3. A rotor as claimed in Claim 1 or 2, wherein:

   said silencing portions (24) comprise lateral surfaces in opposition to said lateral surfaces (17) of said pole fingers; and
   said projections (28) extend from said lateral surfaces of said silencing portions (24).

4. A rotor as claimed in Claim 3, wherein said lateral surfaces (17) of said pole fingers (16) and said opposing lateral surfaces of said silencing portions (24) define gaps therebetween.

5. A rotor as claimed in Claim 3 or 4, wherein:

   said pole fingers (16) are generally triangular, thereby each comprising a tip; and
   said silencer (22) further comprises portions (26) bridging said silencing portions (24), said bridging portions extending under said tips of said pole fingers (16).

6. A rotor as claimed in Claim 5, wherein the only points of contact between said silencer (22) and said pole fingers (16) are between said tips of said pole fingers (16) and said bridging portions (26) of said silencer (22), and between said projections (28) and said lateral surfaces (17) of said pole fingers (16).

7. A rotor as claimed in Claim 5, wherein the only points of contact between said silencer (22) and said pole fingers (16) when said rotor is at rest are between said tips of said pole fingers (16) and said bridging portions (26) of said silencer (22).

8. A rotor as claimed in Claim 3 or any claim appended thereto, wherein said projections (28) have a length in a direction along said lateral surfaces (17) of said pole fingers (16) less than the length of the lateral surfaces of said pole fingers.

9. A rotor as claimed in Claim 8, wherein said projections (28) have a length in a direction along said lateral surfaces (17) of said pole fingers of approximately 3 millimetres.

10. An alternator comprising a rotor (10) as claimed in any preceding claim rotatably mounted within and in opposition to a stator (23).

Patentansprüche

1. Ein Rotor für eine elektrische Maschine, wobei dieser Rotor (10) folgendes umfaßt:

   Einen ersten und einen zweiten Polschuh (12,

14), die zusammen eine Rotationsachse festlegen, wobei beide diese Polschuhe (12, 14) Polfinger (16) besitzen, die sich im wesentlichen parallel zu dieser Rotationsachse erstrekken, und wobei diese Polfinger (16) seitliche Flächen (17) besitzen und diese Polfinger (16) dieser Polschuhe ineinander eingreifen, wobei jedes Paar benachbarter, ineinander eingreifender Polfinger (16) ferner dazwischen einen Zwischenraum festlegt; und
einen Schalldämpfer (22), der schalldämpfende Bereiche (24), die diese Zwischenräume mindestens teilweise ausfüllen, und Ansätze (28) umfaßt, die angepaßt sind, mit diesen seitlichen Flächen (17) dieser Polfinger (16) beim Begrenzen der radialen Bewegung dieser schalldämpfenden Bereiche (24) weg von dieser Rotationsachse dieses Rotors (10) zusammenzuwirken.

2. Ein Rotor nach Anspruch 1, worin dieser Schalldämpfer (22) im wesentlichen aus nicht ferromagnetischem Material hergestellt ist.

3. Ein Rotor nach Anspruch 1 oder 2, worin:

Diese schalldämpfenden Bereiche (24) seitliche Flächen umfassen, die diesen seitlichen Flächen (17) dieser Polfinger gegenüberliegen; und
diese Ansätze (28) sich von diesen seitlichen Flächen dieser schalldämpfenden Bereiche (24) erstrecken.

4. Ein Rotor nach Anspruch 3, worin diese seitlichen Flächen (17) dieser Polfinger (16) und diese gegenüberliegenden seitlichen Flächen dieser schalldämpfenden Bereiche (24) Zwischenräume dazwischen festlegen.

5. Ein Rotor nach Anspruch 3 oder 4, worin:

Diese Polfinger (16) allgemein dreieckig sind, weshalb jeder von ihnen eine Spitze umfaßt; und
dieser Schalldämpfer (22) ferner Bereiche (26) umfaßt, die diese schalldämpfenden Bereiche (24) überbrücken, wobei sich diese Überbrükkungsbereiche unter diese Spitzen dieser Polfinger (16) erstrecken.

6. Ein Rotor nach Anspruch 5, worin sich die einzigen Berührungspunkte zwischen diesem Schalldämpfer (22) und diesen Polfingern (16) zwischen diesen Spitzen dieser Polfinger (16) und diesen Überbrükkungsbereichen (26) dieses Schalldämpfers (22) befinden, sowie zwischen diesen Ansätzen (28) und diesen seitlichen Flächen (17) dieser Polfinger (16).

7. Ein Rotor nach Anspruch 5, worin sich die einzigen Berührungspunkte zwischen diesem Schalldämpfer (22) und diesen Polfingern (16) bei ruhendem Rotor zwischen diesen Spitzen dieser Polfinger (16) und diesen Überbrückungsbereichen (26) dieses Schalldämpfers (22) befinden.

8. Ein Rotor nach Anspruch 3 oder irgendeinem daran angefügten Anspruch, worin diese Ansätze (28) eine Länge in einer Richtung entlang diesen seitlichen Flächen (17) dieser Polfinger (16) besitzen, die geringer als die Länge der seitlichen Flächen dieser Polfinger ist.

9. Ein Rotor nach Anspruch 8, worin diese Ansätze (28) eine Länge in einer Richtung entlang diesen seitlichen Flächen (17) dieser Polfinger von etwa 3 Millimeter besitzen.

10. Einen Drehstrommaschine, die einen Rotor (10) nach irgendeinem der vorhergehenden Ansprüche besitzt, der drehbar - und dazu gegenüberliegend - in einem Stator (23) angebracht ist.

Revendications

1. Rotor pour machine électrique, ledit rotor (10) comprenant :

des première et seconde pièces polaires (12, 14) définissant ensemble un axe de rotation, lesdites pièces polaires (12, 14) comportant chacune des griffes de pôles (16) qui s'étendent de façon généralement parallèle audit axe de rotation, lesdites griffes de pôles (16) présentant des faces latérales (17), lesdites griffes de pôles (16) desdites pièces polaires étant emboîtées les unes dans les autres, chaque paire de griffes de pôles (16) emboîtées adjacentes définissant en outre un espace entre elles, et
un amortisseur de bruit (22) comprenant des parties d'amortissement de bruit (24) comblant au moins en partie lesdits espaces, des saillies (28) conçues pour coopérer avec lesdites faces latérales (17) desdites griffes de pôles (16) afin de limiter le déplacement radial desdites parties d'amortisseur de bruit (24) à l'écart dudit axe de rotation dudit rotor (10).

2. Rotor selon la revendication 1, dans lequel ledit amortisseur de bruit 22 est essentiellement fait d'un matériau non ferromagnétique.

3. Rotor selon la revendication 1 ou 2, dans lequel :

lesdites parties d'amortissement de bruit (24) comprennent des faces latérales en opposition avec lesdites faces latérales (17) desdites griffes de pôles, et
lesdites saillies (28) s'étendent à partir desdites faces latérales desdites parties d'amortissement de bruit (24).

4. Rotor selon la revendication 3, dans lequel lesdites faces latérales (17) desdites griffes de pôles (16) et lesdites faces latérales opposées desdites parties d'amortissement de bruit (24) définissent entre elles des espaces.

5. Rotor selon la revendication 3 ou 4, dans lequel :

lesdites griffes de pôles (16) sont sensiblement triangulaires, en formant ainsi chacune une pointe, et
ledit amortisseur de bruit (22) comprend en outre des parties (26) reliant lesdites parties d'amortissement de bruit (24), lesdites parties de liaison s'étendant sous lesdites pointes desdites griffes de pôles (16).

6. Rotor selon la revendication 5, dans lequel les seuls points de contact entre ledit amortisseur de bruit (22) et lesdites griffes de pôles (16) sont situés entre lesdites pointes desdites griffes de pôles (16) et lesdites parties de liaison (26) dudit amortisseur de bruit (22), et entre lesdites saillies (28) et lesdites faces latérales (17) desdites griffes de pôles (16).

7. Rotor selon la revendication 5, dans lequel les seuls points de contact entre ledit amortisseur de bruit (22) et lesdites griffes de pôles (16) lorsque ledit rotor est à l'arrêt sont situés entre lesdites pointes desdites griffes de pôles (16) et lesdites parties de liaison (26) dudit amortisseur de bruit (22).

8. Rotor selon la revendication 3 ou l'une quelconque des revendications dépendant de celle-ci, dans lequel lesdites saillies (28) présentent une longueur dans la direction s'étendant le long desdites faces latérales (17) desdites griffes de pôles (16) qui est inférieure à la longueur des faces latérales desdites griffes de pôles.

9. Rotor selon la revendication 8, dans lequel lesdites saillies (28) présentent une longueur dans la direction qui s'étend le long desdites faces latérales (17) desdites griffes de pôles qui est d'approximativement 3 mm.

10. Alternateur comprenant un rotor (10) selon l'une quelconque des revendications précédentes, monté en rotation à l'intérieur d'un stator (23) et en opposition à celui-ci.

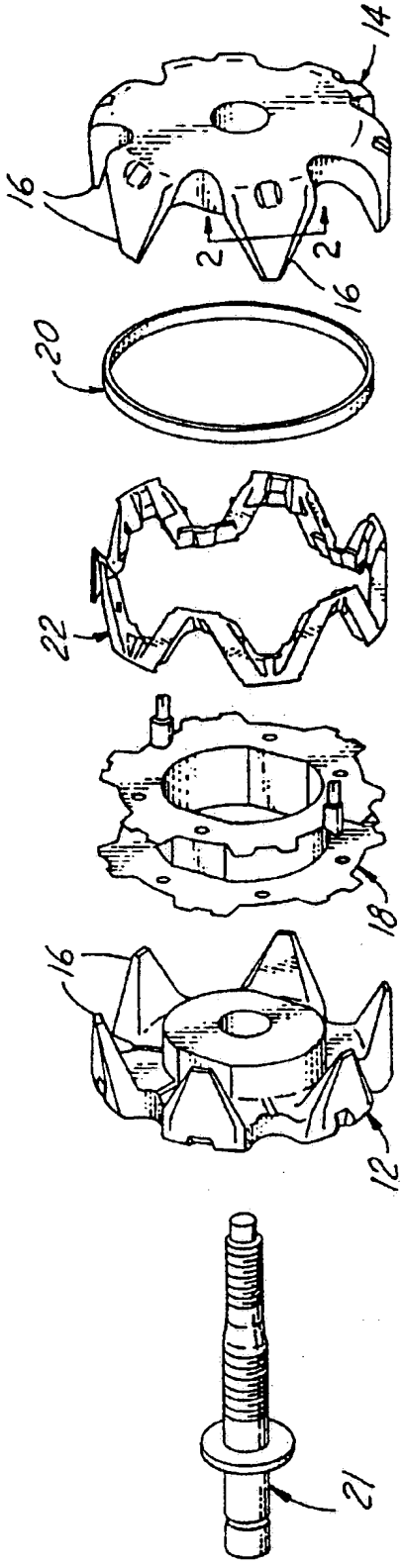

FIG. 1

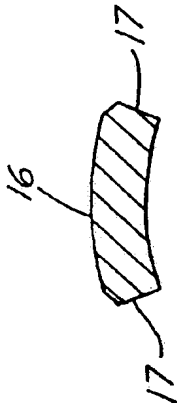

FIG. 2

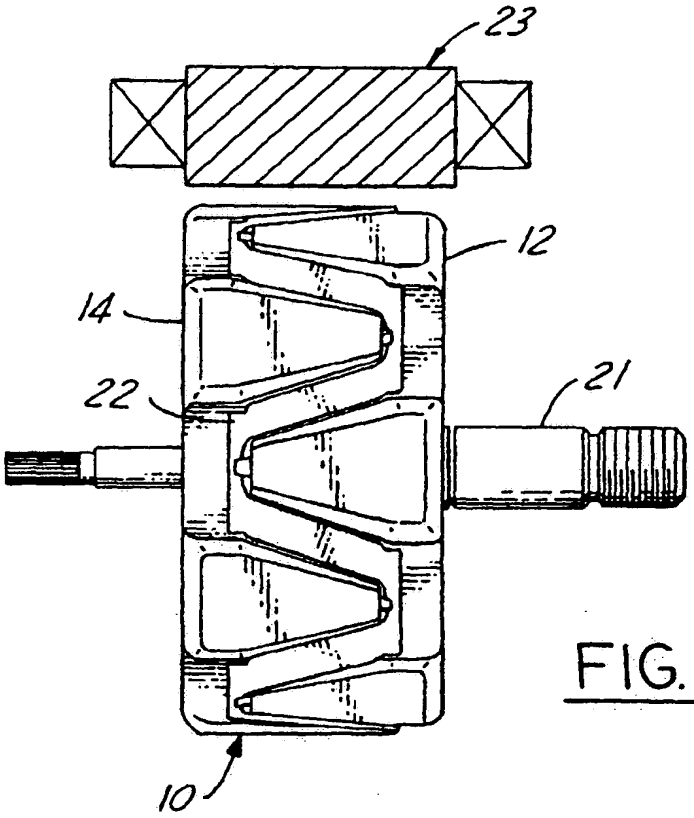

FIG.3

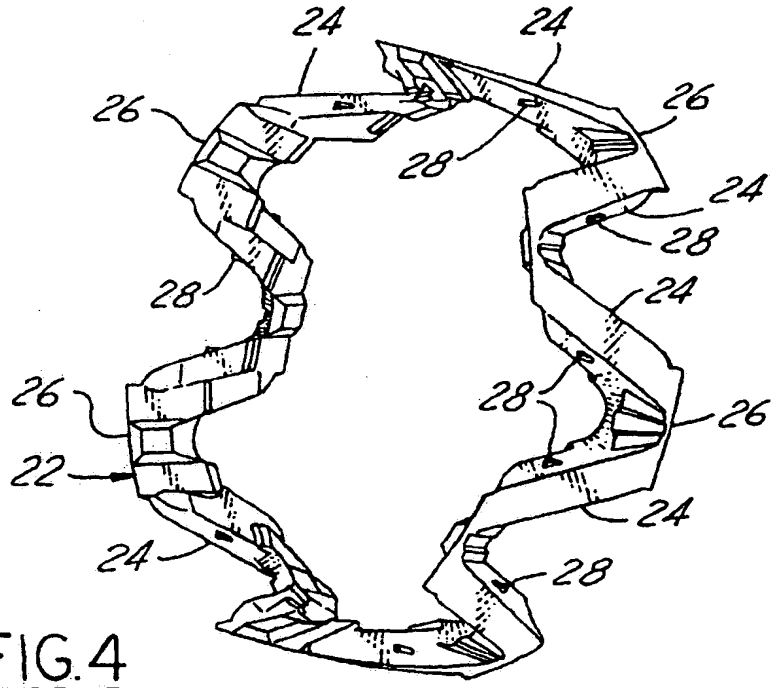

FIG.4